

Planetary Defense Coordination Office

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PAC Finding 3

- Given the importance of planetary defense to NASA and the public, PAC recommended at its previous meeting in February, 2018 that NASA's Planetary Defense Coordination Office (PDCO) make regular reports to the PAC on the progress and plans being made in regards to meeting the George E. Brown survey objective of detecting and tracking >90% of Near Earth Objects (NEOs) larger than 140m, and smaller NEOs. Now that the Administration has requested a significant increase in FY19 funding for PDCO, PAC would like to see the PDCO program objectives, summary program plan to meet these objectives, and roadmap with dates of key milestones included in the complete PDCO report at the next PAC meeting.



NATIONAL NEAR-EARTH OBJECT PREPAREDNESS STRATEGY AND ACTION PLAN

A Report by the
INTERAGENCY WORKING GROUP FOR DETECTING AND MITIGATING
THE IMPACT OF EARTH-BOUND NEAR-EARTH OBJECTS

of the
NATIONAL SCIENCE & TECHNOLOGY COUNCIL

JUNE 2018

New Guidance released by White House on 20 June 2018

<https://www.whitehouse.gov/wp-content/uploads/2018/06/National-Near-Earth-Object-Preparedness-Strategy-and-Action-Plan-23-pages-1MB.pdf>



Interagency Working Group Membership

- Department of Commerce (NOAA)
- Department of Defense (USAF, USSTRATCOM)
- Department of Energy (NNSA)
- Department of Homeland Security (FEMA)
- Department of the Interior (USGS)
- Department of State (OES)
- NASA Planetary Defense Coordination Office (PDCO) (Co-Chair)
- National Science Foundation (AST)
- National Security Council
- Office of the Director of National Intelligence
- Office of Management and Budget
- Office of Science and Technology Policy (Co-chair)



National NEO Preparedness Strategy and Action Plan

Goals in the New Action Plan

1. Enhance NEO Detection, Characterization, and Tracking Capabilities
2. Improve Modeling, Predictions, and Information Integration
3. Develop Technologies for NEO Deflection and Disruption
4. Increase International Cooperation on NEO Preparation
5. Establish NEO Impact Emergency Procedures and Action Protocols



Planetary Defense Coordination Office

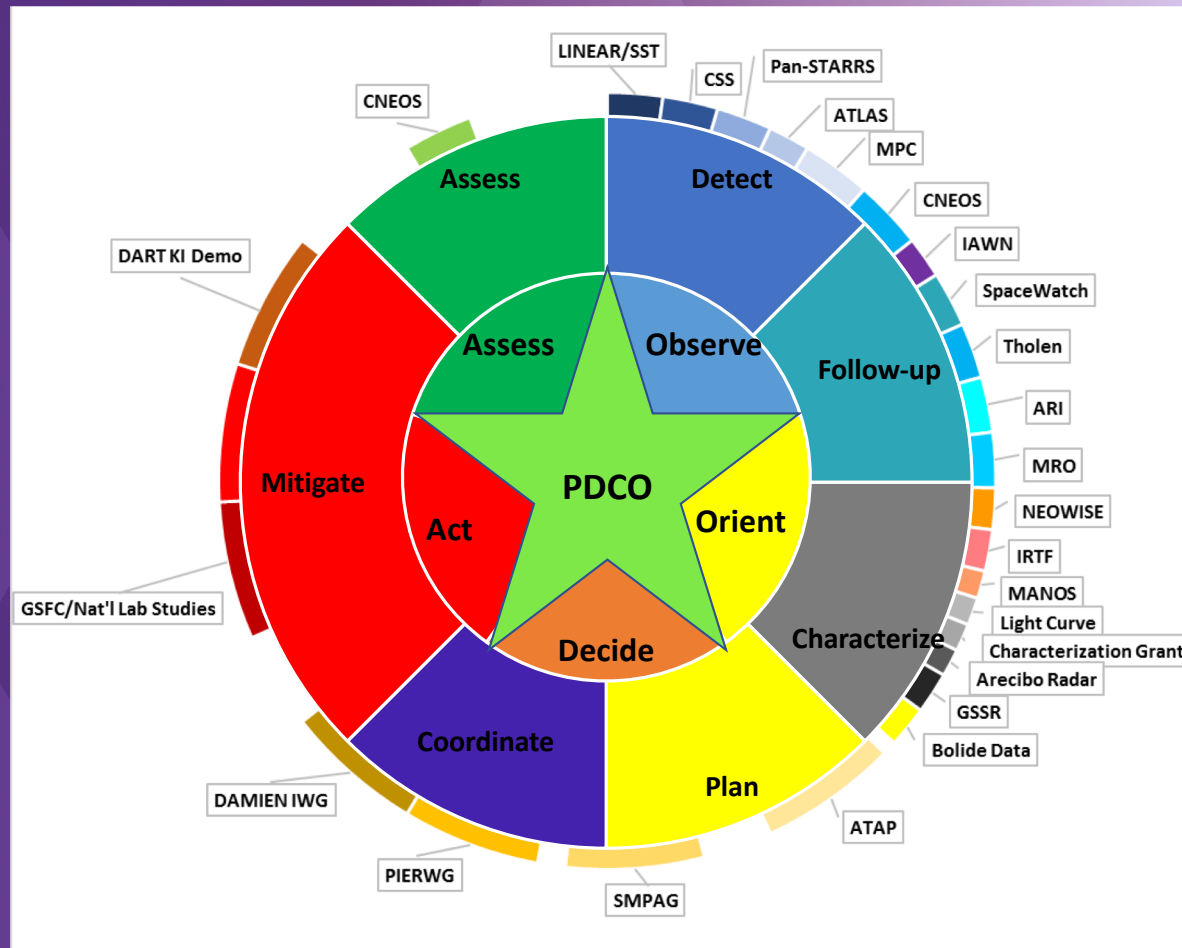
- Established in January 2016 at NASA HQ to oversee ongoing and developing planetary defense related activities across NASA, and coordinate both US interagency and international efforts and projects to address and plan response to the asteroid impact hazard.

Mission Statement:

Lead national and international efforts to:

- Detect any potential for significant impact of planet Earth by natural objects
- Appraise the range of potential effects by any possible impact
- Develop strategies to mitigate impact effects on human welfare

Planetary Defense Projects

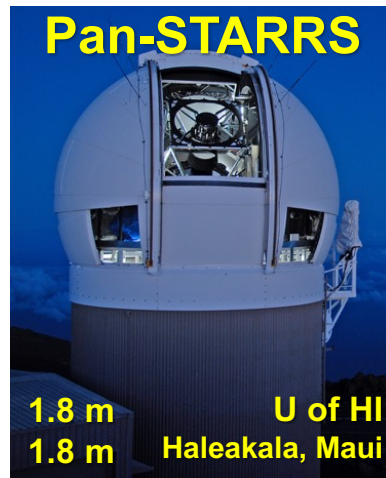


NEO Observations Program

NASA Authorization Act of 2005 increased scope of objectives:

- Amended National Aeronautics and Space Act of 1958 (“Space Act”) to add:
 - “The Congress declares that the general welfare and security of the United States require that the unique competence of the National Aeronautics and Space Administration be directed to detecting, tracking, cataloguing, and characterizing near-Earth asteroids and comets in order to provide warning and mitigation of the potential hazard of such near-Earth objects to the Earth.”
- **Made NEO detection, tracking and research 1 of 7 explicitly stated purposes of NASA**
- Provided additional direction:
 - “...plan, develop, and implement a Near-Earth Object Survey program to detect, track, catalogue, and characterize the physical characteristics of near-Earth objects equal to or greater than **140 meters** in diameter in order to assess the threat of such near-Earth objects to the Earth. It shall be the goal of the Survey program to achieve **90 percent completion** of its near-Earth object catalogue **within 15 years [by 2020]**” [emphasis added]

NASA's NEO Search Program (Current Survey Systems)



NASA's NEO Data Processing and Management



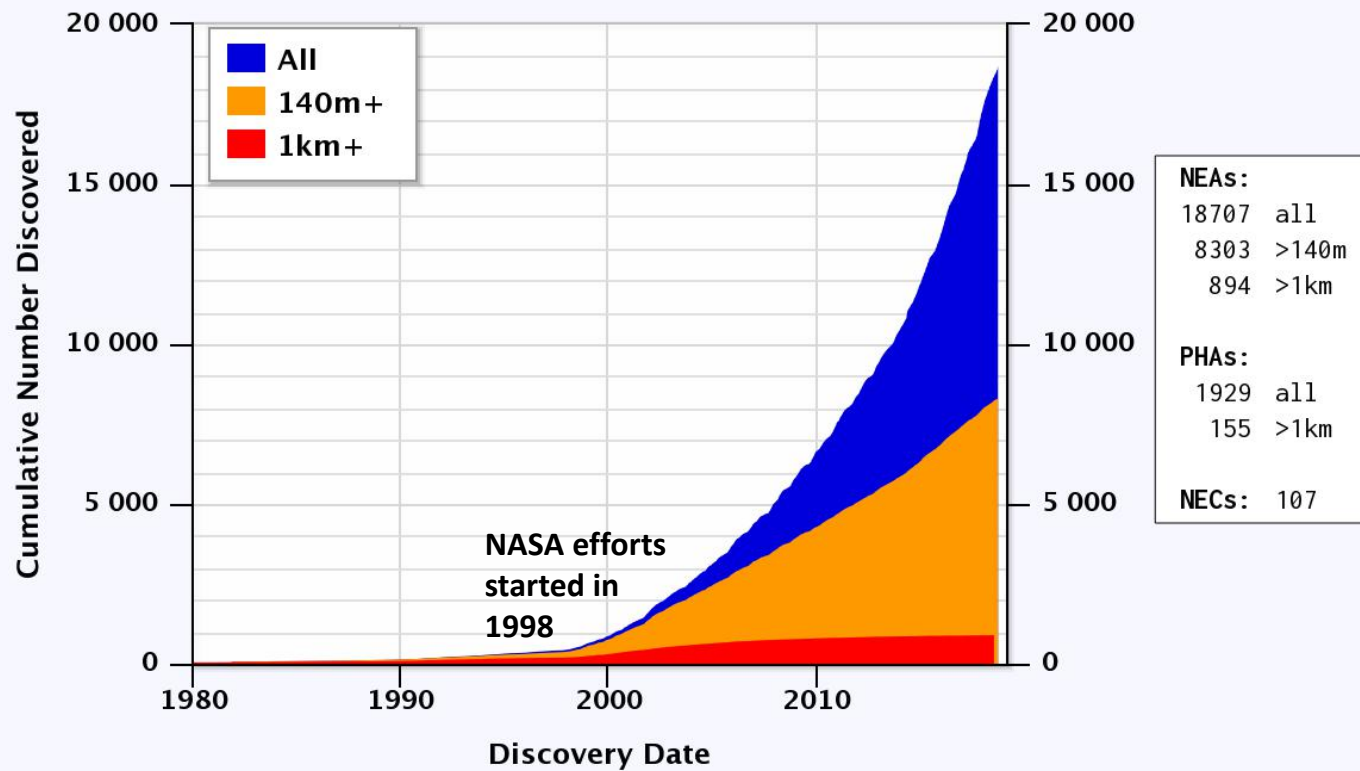
- Receives positional measurement of small bodies from observations made all over the world (and beyond)
- Responsible for identification, designation and initial orbit computation
- Now operating under the **Planetary Data System's Small Bodies Node**



- Computes high-precision orbits of near-Earth objects
- Performs long-term analyses of possible future orbits of hazardous asteroids (Sentry) and computes orbits for new potential asteroid discoveries to determine any impact hazard (Scout)
- Predicts the impact time, location and geometry in the event of a predicted impact

Near-Earth Asteroids Discovered

Most recent discovery: 2018-Sep-15



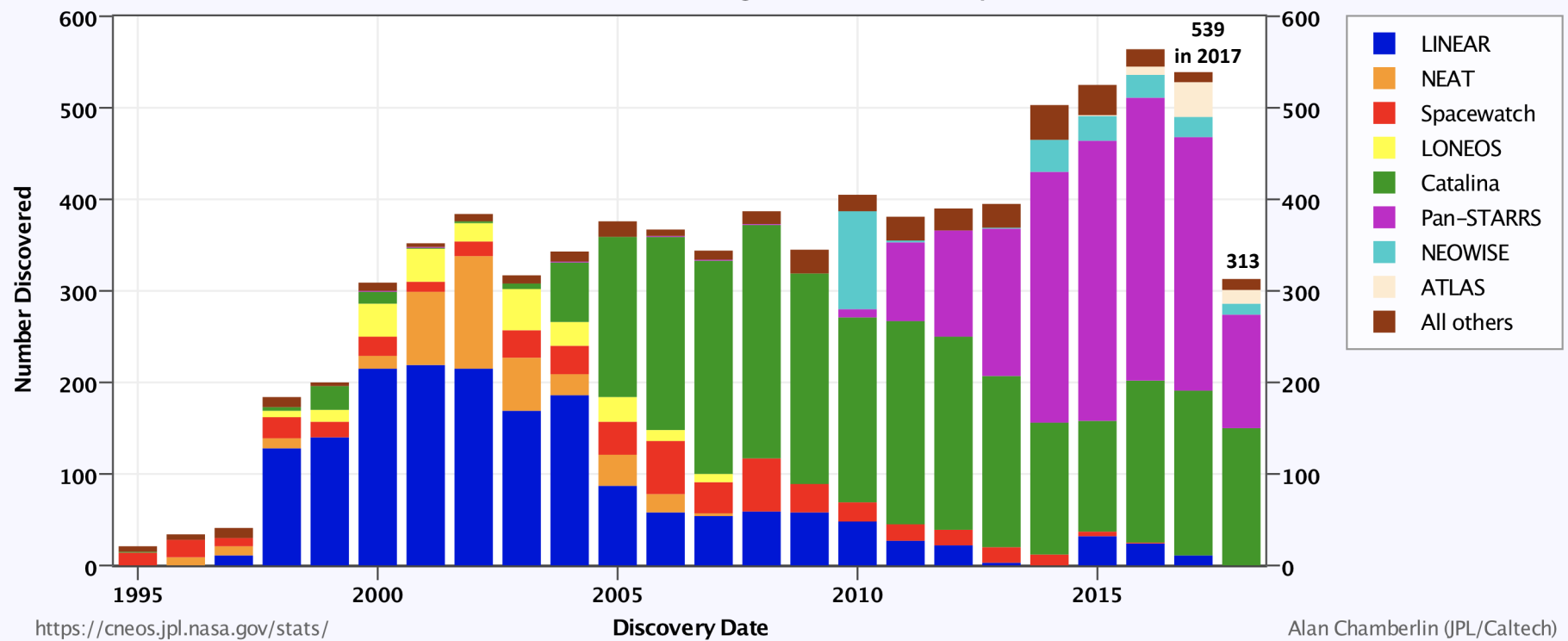
<https://cneos.jpl.nasa.gov/stats/>

Alan Chamberlin (JPL/Caltech)

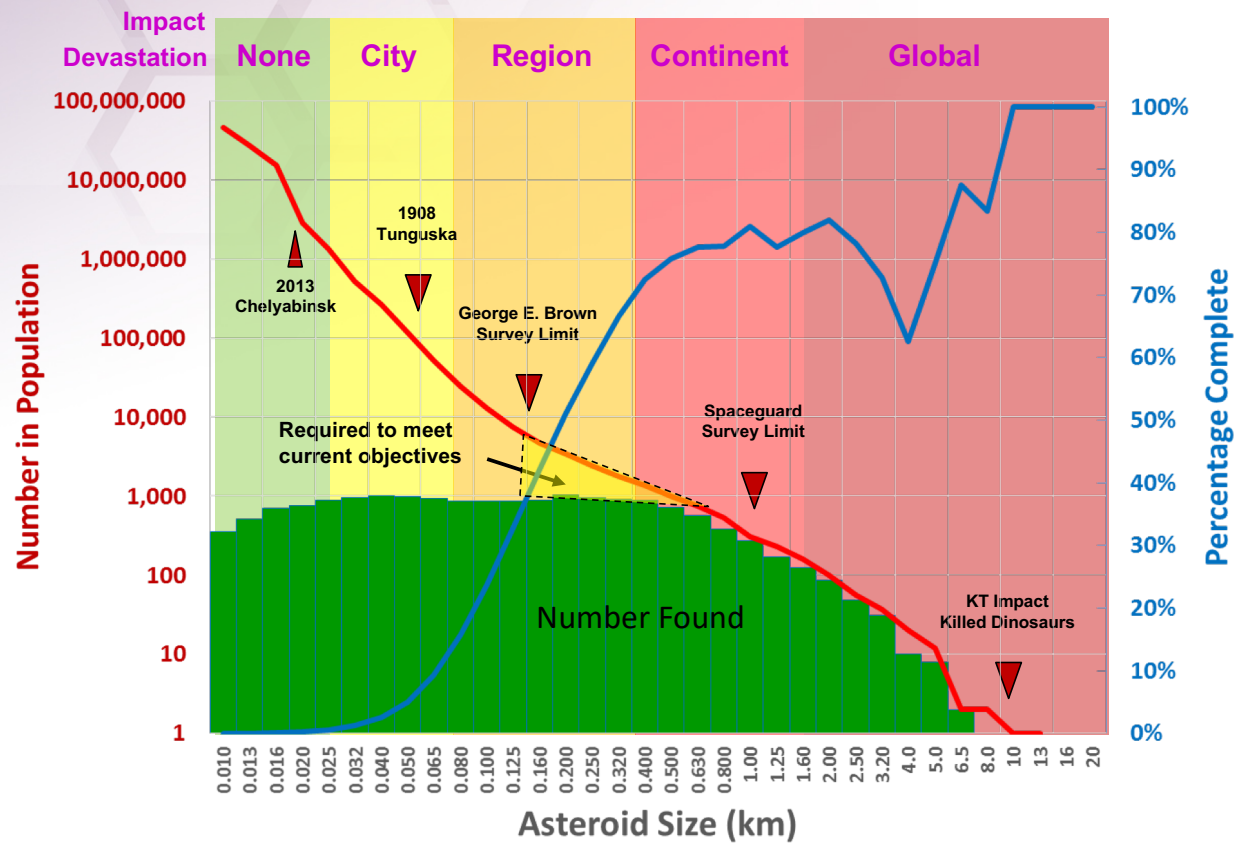
**Potentially Hazardous Asteroids (PHAs) come within 7.5 million km of Earth orbit*

Near-Earth Asteroid Discoveries by Survey

~140m and larger NEAs (as of 2018-Sep-18)



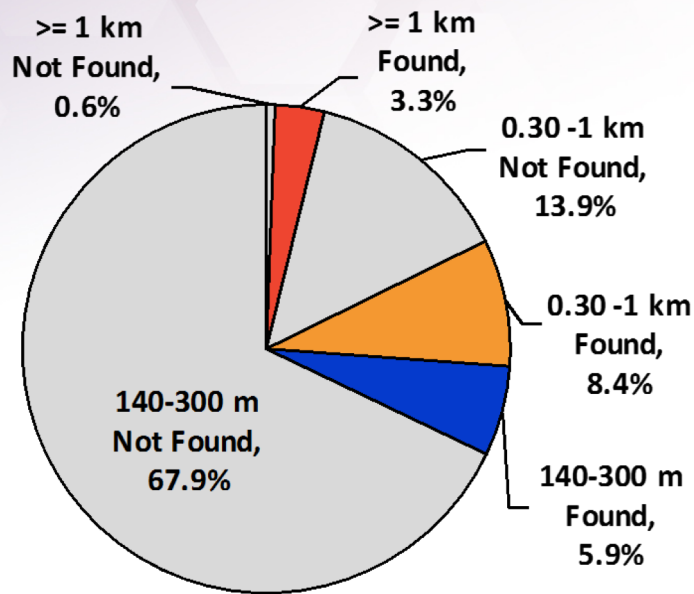
Near-Earth Asteroid Population and Survey Progress - 2017



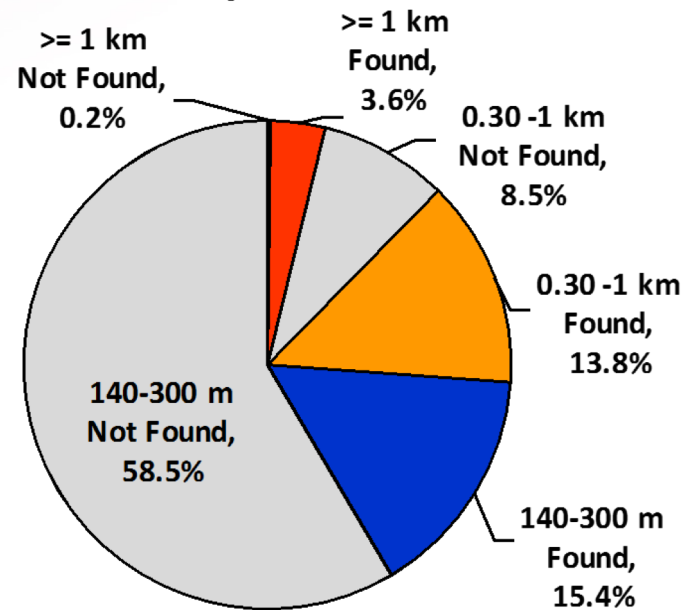
NEO Population - 140 meters and larger

Total population estimated to be ~ 25,000

NEO Survey Status Jan 2010

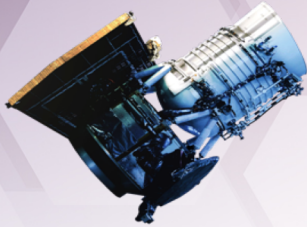


NEO Survey Status Jan 2018



At current rate of discovery it will take >32 years to accomplish Goal

PDCO Flight Mission Projects

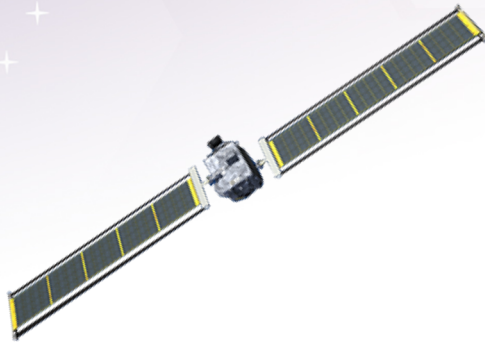


NEOWISE

- Continues in extended NEO survey operations
- Expected to exceed max useful temps in Summer 2019

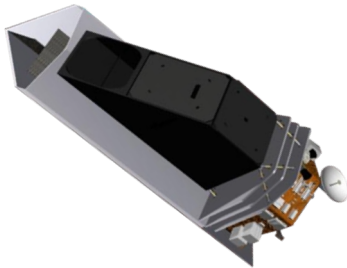
DART: Double Asteroid Redirection Test

- Demonstration of kinetic impactor technique
- Target - Moon of 65803 Didymos
- Launch NET Jun 2021, impact Oct 2022
- Completed Mission-level PDR 10-12 April 2018
- KDP-C “Confirmation” signed 16 August 2018
- CDR scheduled for June 2019



NEOCam: Near-Earth Object Camera

- Infrared survey telescope optimized for meeting congressional goal to find and characterize NEOs down to 140 meters in size
- Finished Extended Phase A Study
- SRR/MDR completed 27-28 February 2018
- NEO survey instrument development to continue



Double Asteroid Redirection Test (DART) Mission Concept

DART Spacecraft

540 kg Arrival Mass
20m² ROSA
NEXT-C Thruster
DRACO Imager
6.0 km/s Closing Speed

Possible SmallSat

6U Argomoon Design
WFOV and NFOV Imagers
Agenzia Spaziale Italiana

Didymos-A

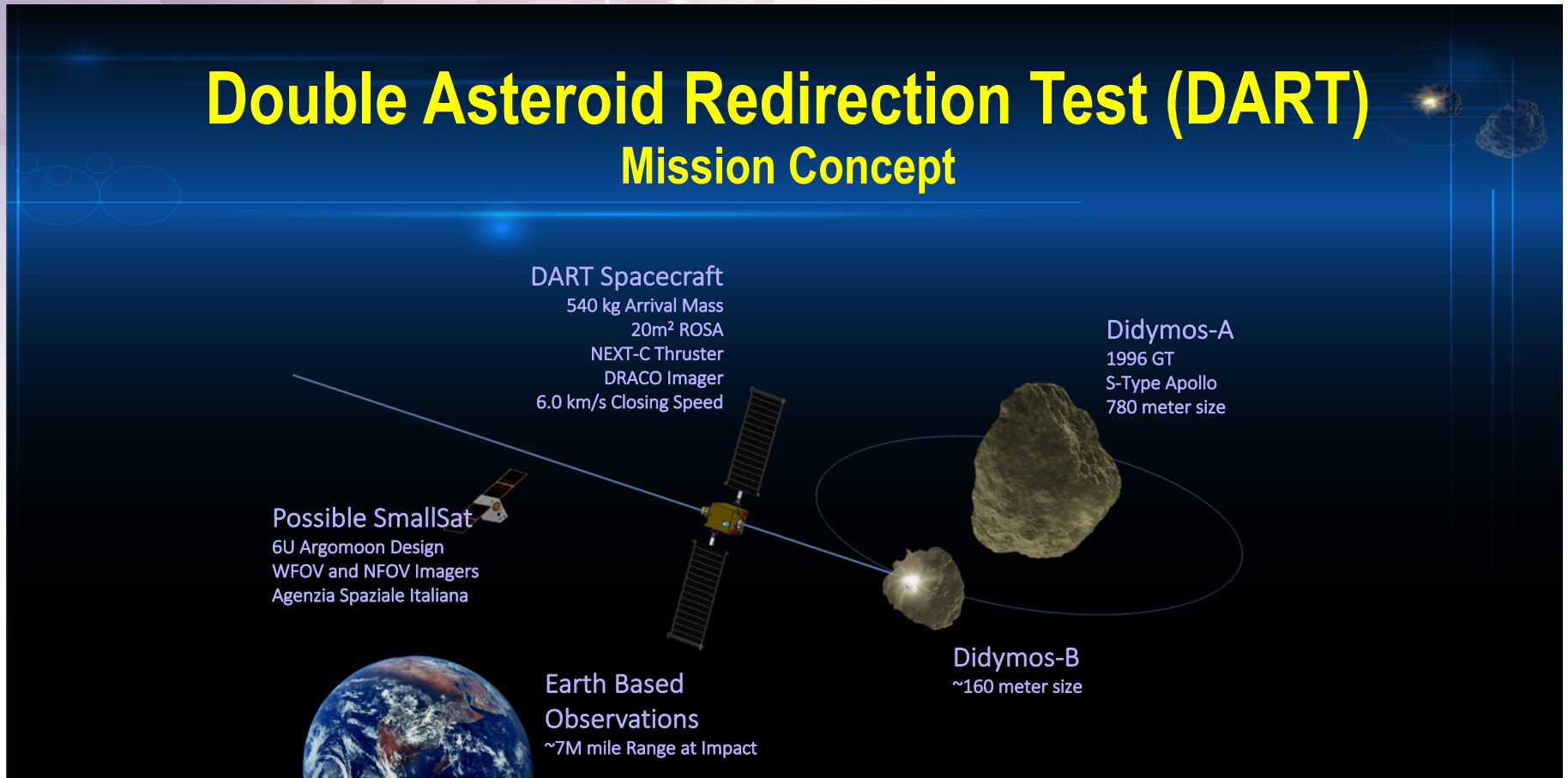
1996 GT
S-Type Apollo
780 meter size

Didymos-B

~160 meter size

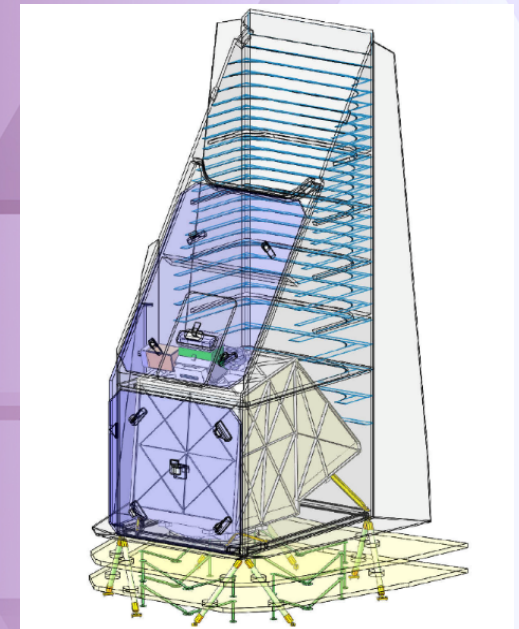
Earth Based Observations

~7M mile Range at Impact



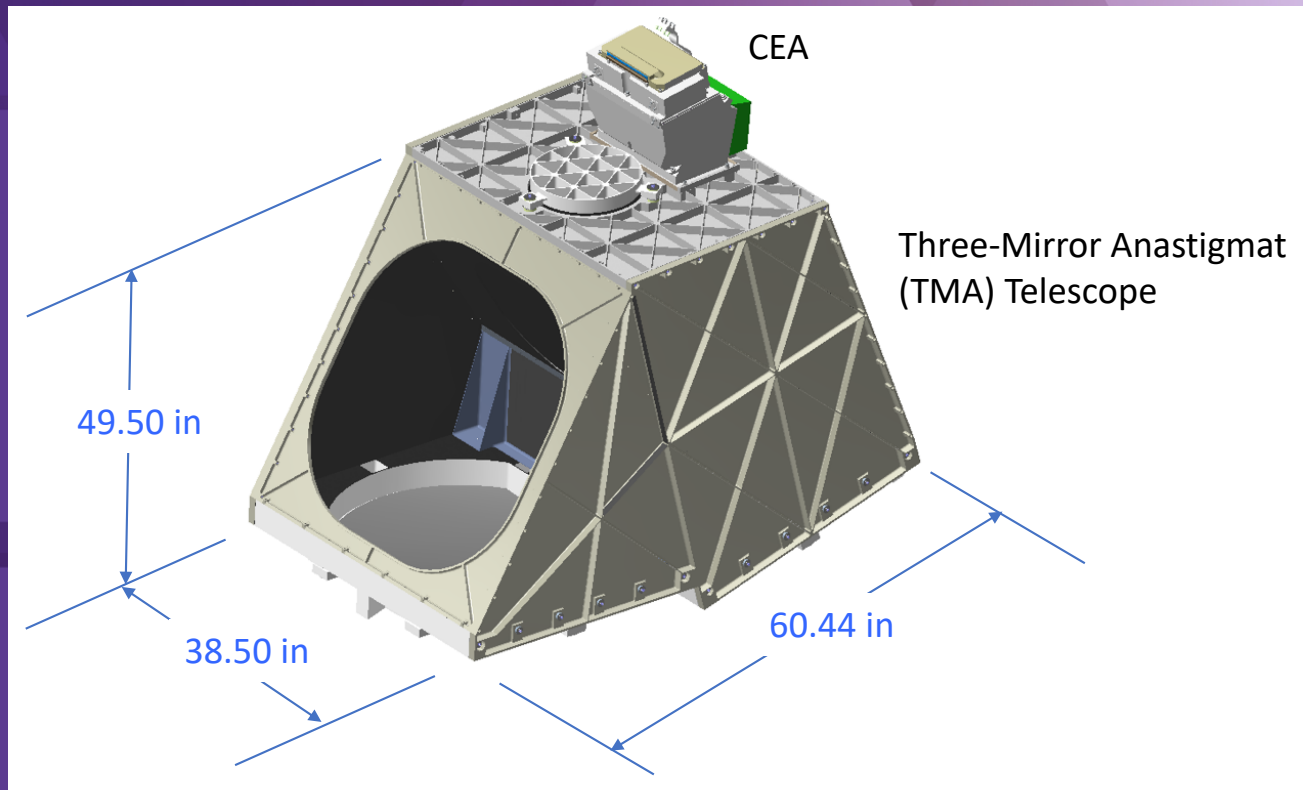
NEO Survey Instrument Development

- 50 cm unobscured aperture, wide FOV telescope for NEO detection at 4-10 μm (Infrared)
 - **Optimized to detect NEOs** at wavelengths where they are bright, but background stars and galaxies are dim
- Passively cooled
 - Enabled by
 - Mission design: Position at Sun-Earth L1
 - HgCdTe high temperature detectors
 - 57K for NC1 (4-5.2 μm)
 - 40K for NC2 (6-10 μm)
 - 2K x 8K mosaic for each channel
- Single instrument optimized for detecting moving objects; it requires no cryogenics and has no moving parts except for a one-time ejectable aperture cover



NEO Survey Instrument Development

Approximate Dimensions of the Telescope Component of the IR Instrument



Planetary Defense Program Roadmap

Project(s)	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	Achieve GEB Goal	
SEARCH & CHARACTERIZATION									
Current GB Projects	Operations						Continued Ops??		2050s ??
LSST		Develop Capability			10 year Operations				2040s??
Space-based									
NEOWISE	EOM								
SB IR NEO DTC*	Instrument Development			Mission Development			LRD 2025	Operate	2036
MITIGATION									
DART KI Demo			LRD June	Didymos					
Gravity Tractor Demo					Begin Formulation		Development		
*Detect, Track, & Characterize									